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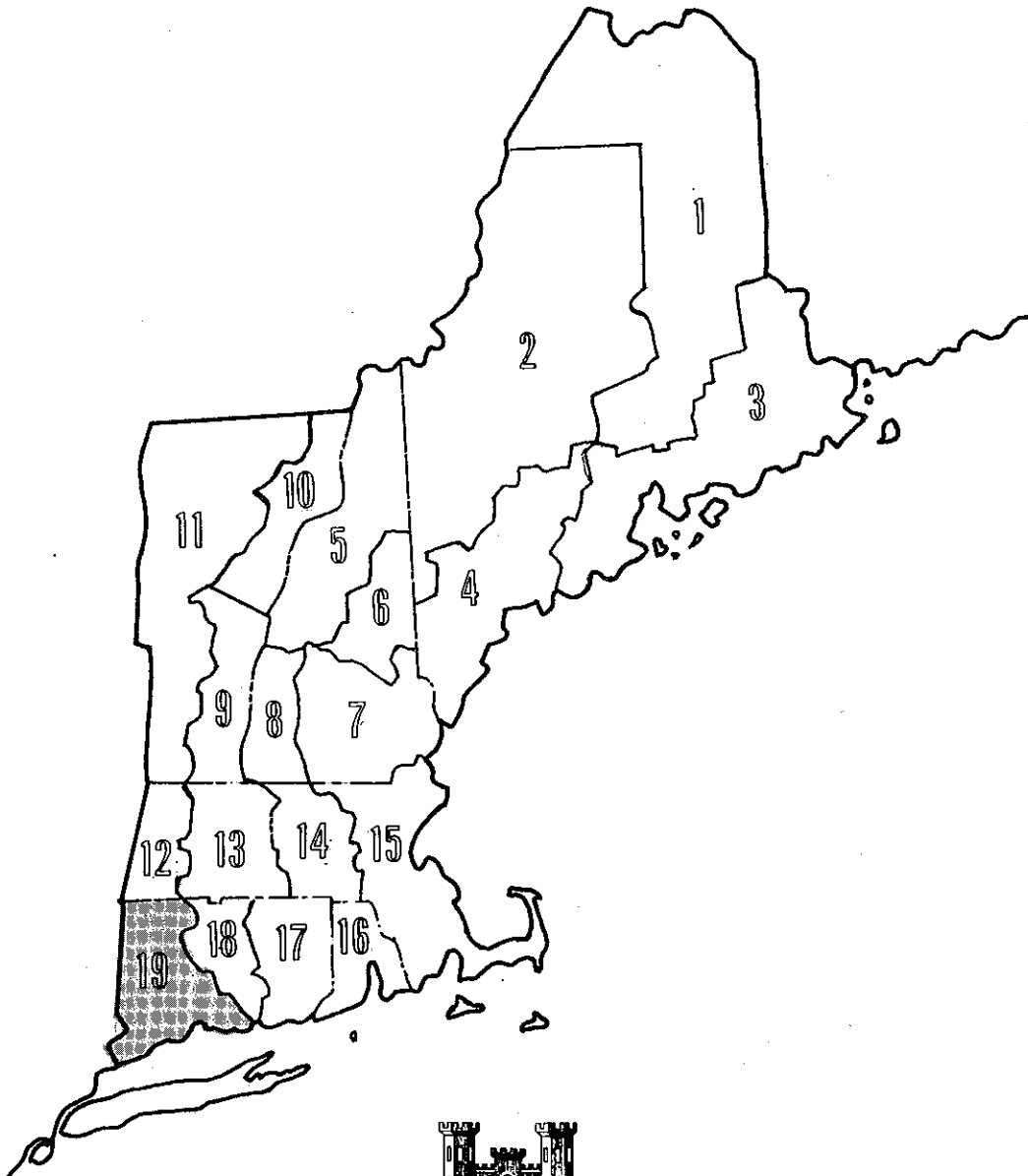
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NORTHEASTERN UNITED STATES WATER SUPPLY STUDY

BRIDGEPORT-NEW HAVEN SUB-REGION

OBE SUB-REGION 19

INTERIM MEMORANDUM NO. 3



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

JULY 1968

NORTHEASTERN UNITED STATES WATER SUPPLY STUDY

INTERIM MEMO NO. 3

BRIDGEPORT-NEW HAVEN SUB-REGION
(OBE SUB-REGION NO. 19)

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY
July 1968

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ABSTRACT

The Bridgeport-New Haven Sub-Region is investigated to determine future potential water supply deficits. Present populations and water supply requirements are discussed. Projections for future populations and water supply needs are presented through the year 2020.

Adequacy of the major water systems is studied and apparent urgent needs and future needs are discussed. Recommendations for funds are requested under "NEWS" legislation (P. L. 89-298) for further study for both urgent needs and future water supply needs of the area.

Bridgeport-New Haven Sub-Region
OBE Sub-Region No. 19
Interim Memo No. 3

1. Purpose of Report

This Interim Memo is being submitted in accordance with scope of work detailed in memorandum dated 21 November 1967, as part of this Division's participation in the Northeast Water Supply Study for the New England area.

2. Scope of Studies

a. General Information. Studies and investigations of reconnaissance scope have been made to determine the projected water supply requirements and potential deficiency areas within OBE Sub-Region No. 19, which is composed of 76 municipalities, 14 cities and 62 towns. An industrial belt stretches along the Naugatuck River Valley and down the coast to New York City and it is within this belt that the bulk of the population reside. Nearly 84% of the sub-region's 1960 population was reported located in this industrial zone which houses such major cities as Waterbury, New Haven and Bridgeport. This industrial belt forms the urban core of the sub-region and projections indicate the greatest future gains in population are to be experienced in this area. Urban population is expected to increase from 84% of the reported 1960 sub-region population of 1,469,726 to 90% in 1980, and 95% in 2020 of the total sub-region. Since the majority of the population will be located in this urban band it is here that this report has concentrated its efforts. A listing of municipalities in the sub-region with their 1960 populations and a plan showing their location in the sub-region are given on Plate No. 1.

Personal contact and liaison was established with selected major municipal and privately owned water systems, their engineering consultants, representatives of the Connecticut Department of Public Health, members of the U.S. Department of Health, Education and Welfare, and 3 of the Connecticut Planning Region agencies located in the sub-region.

During meetings with the various municipal and private water system officials, the aim, object, and purpose of the Northeast Water Supply Study was discussed and pledges of full

cooperation were received. At these meetings, the municipalities and private companies concerned outlined their present and future water supply capabilities and presented their views on future problem areas. Valuable information in the form of architect-engineer reports, municipal reports, company reports and agency reports were also collected.

Although there are many industries in the area who now maintain their own water supply sources, the scope of this study did not permit evaluation of these industrial user's future plans. Lack of information and potential future requirements for these industrial users from the municipal systems is a major limitation to the study. The evaluations of the water systems in this report, therefore, are based on projected population demands and presently serviced industrial requirements and do not include any major shift of industries now utilizing their own private supplies to the municipal or private water companies systems.

b. Office Studies. Office studies included collection and evaluation of data received. Preliminary projections of water supply requirements and population for the individual systems and sub-region were prepared. Deficiency areas which may be developing with respect to source, conveyance and treatment facilities were determined. Proposals for plans and alternate solutions based on preliminary hydrologic and cost estimates were developed and are contained later in this report.

c. Field Reconnaissance. A field reconnaissance was made of possible future facility sites within the sub-region.

d. Topographic Surveys. Topographic information was obtained from U. S. Geological Survey maps scale 1:24,000, 1:62,500 and 1:250,000.

e. Geologic and Subsurface Information. Subsurface data was obtained from U. S. Geological Survey publications, consulting engineer reports and reports prepared by the Connecticut Development Commission.

3. Prior Reports

a. Water Resources were considered in Part 2, Chapter XXII "Housatonic River Basin" and Chapter XXIII "Connecticut

LITCHFIELD COUNTY

Barkamsted	1,370
Bethlehem	1,486
Bridgewater	898
Canaan	790
Colebrook	791
Cornwall	1,051
Goshen	1,288
Harwinton	3,344
Kent	1,686
Litchfield	6,264
Morris	1,190
New Hartford	3,033
New Milford	8,318
Norfolk	1,827
North Canaan	2,836
Plymouth	8,981
Roxbury	912
Salisbury	3,309
Sharon	2,141
Thomaston	5,850
Torrington	30,045
Warren	600
Washington	2,603
Watertown	14,837
Winchester	10,496
Woodbury	3,910

Total 119,856

FAIRFIELD COUNTY

Bethel	8,200
Bridgeport	156,748
Brookfield	3,405
Danbury	39,382
Darien	18,437
Easton	3,407
Fairfield	46,183
Greenwich	53,793
Monroe	6,402
New Canaan	13,466
New Fairfield	3,355
Newtown	11,373
Norwalk	67,775
Redding	3,359
Ridgefield	8,165
Shelton	18,190
Sherman	825
Stamford	92,713
Stratford	45,012
Trumbull	20,379
Weston	4,039
Westport	20,955
Wilton	8,026

Total 653,589

NEW HAVEN COUNTY

Ansonia	19,819
Beacon Falls	2,886
Bethany	2,384
Branford	16,610
Cheshire	13,383
Derby	12,132
East Haven	21,388
Guilford	7,913
Hamden	41,056
Madison	4,567
Meriden	51,850

Middlebury	4,785
Milford	41,662
Naugatuck	19,511
New Haven	152,048
North Branford	6,771
North Haven	15,935
Orange	8,547
Oxford	3,292
Prospect	4,367
Seymour	10,100
Southbury	5,186
Wallingford	29,920
Waterbury	107,130
West Haven	43,002
Wolcott	8,889
Woodbridge	5,182

Total 660,315

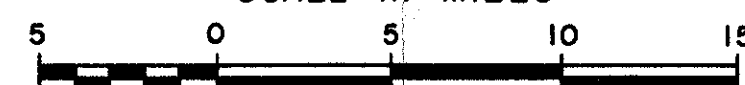
NOTE: THE HARTFORD METROPOLITAN AREA IS LOCATED IN SUB-REGION #18 AND WILL BE STUDIED IN A SUBSEQUENT MEMO

NORTHEASTERN UNITED STATES WATER SUPPLY STUDY

OBE SUB-REGION #19 (BRIDGEPORT-NEW HAVEN)

COUNTIES, MUNICIPALITIES AND 1960 POPULATIONS

SCALE IN MILES



Coastal Area" of the Resources of the New England-New York Region. These comprehensive reports inventoried the resources of the New England-New York area and recommended a master plan to be used as a guide for the regional planning, development, conservation and use of land, water and related resources of the region. Prepared by the New England-New York Inter-Agency Committee, (NENYIAC) the report was submitted to the President of the United States by the Secretary of the Army on 27 April 1956. Part 1 and Chapter 1 of Part 2 are printed as Senate Document No. 14, 85th Congress, 1st Session.

b. A report titled "Interim Report on Review of Survey for Flood Control, Connecticut River Basin, Farmington River Basin, Connecticut and Massachusetts" covering the Farmington River and its tributaries with respect to flood control, flood protection, water power, pollution abatement, water supply, recreation, and a combination of these features was printed as House Document No. 443, 86th Congress.

c. A report titled "Report on Review of Survey for Flood Control and Allied Purposes, Pequonnock River Basin, Connecticut", recommends inclusion of storage for water supply purposes. This report was printed as Senate Document No. 115, 89th Congress.

4. Description of Sub-region No. 19

a. General. Sub-region No. 19 Bridgeport-New Haven is located in western Connecticut and the majority of the area is in the Housatonic River Basin with the remainder situated in the Connecticut River Basin and drainage areas of small coastal rivers. The area includes the counties of Litchfield, New Haven and Fairfield. Climate is generally moderate with average monthly temperatures ranging from 20° F in January to 73° F in August. The distribution of the mean precipitation is approximately uniform throughout the year with the mean annual precipitation of 46 inches being higher than the national average.

The northern half of the sub-region is semi-mountainous and primarily rural in nature while the less hilly southern half is marked by extensive urban development. The major cities of Waterbury, New Haven and Bridgeport are located in the

southern half in an industrial belt which extends down the Naugatuck River Valley and along the coast to New York City. It is this industrial zone which forms the industrial and urban center of the sub-region. Sub-region No. 19 reported a population of 1,469,726 in 1960 of which 84% was located in the municipalities comprising the metropolitan complex of the area. Projections prepared by Arthur D. Little, Inc., and submitted in their report "Projective Economic Studies of New England" indicate sub-region population of 1,994,000 in 1980, 2,734,000 in 2000 and 3,659,000 in 2020. Urban population is expected to increase from its 1960 level of 84% to 90% by 1980 and 95% in 2020. Population projections developed in the Economic Base for the North Atlantic Regional Water Resources Study differ from the ADL projections by 2.8% in 1980, 5.6% by 2000 and 8.1% by 2020.

b. Surface Water. The Housatonic River (drainage area 1950 sm), which drains most of the sub-region, is the sixth largest river in New England. Five large tributaries located with their confluences in Connecticut contribute to the flow in the Housatonic. These are the Naugatuck, Ten Mile, Shepaug, Pomperaug and Still Rivers. The largest of these is the Naugatuck River draining 312 square miles and the smallest is the Still River draining 71.5 square miles. A portion of the Shepaug River, about 38 sm, is used as a source of supply for the City of Waterbury and is diverted into the Naugatuck River basin.

c. Ground Water Geology.⁽¹⁾ In sub-region No. 19 the most favorable areas for development of ground water resources are found in the valleys of the larger rivers and streams and along the lowlands adjacent to Long Island Sound. In general it is these locations where stratified glacial deposits have been found.

Sedimentary rocks consisting of sandstone and shale mixed with crystalline rocks consisting of basalt are found in the lowland area that extends northward from New Haven to Granby. Wells located in this area generally yield a small to moderate supply. Fluctuations in the ground water level in New Haven, in areas of heavy water user pumping has been substantial. In some areas of New Haven wells have been subject to salt water intrusion.

⁽¹⁾ Connecticut Development Commission, Technical Report 124

The uplands of the area are generally composed of gneiss, schist, marble and some basalt. Yields from these areas range from small to moderate and although adequate for domestic and small industrial users would probably not be sufficient for heavy water use industry.

d. Existing Wells. Although the primary source of water for the major water utilities is surface water, development of ground water resources serve as a valuable supplement. At present, the major systems have developed, or will shortly develop wells with an estimated safe yield of 41 mgd. The majority of this yield (24.2 mgd) is available from the Bridgeport Hydraulic Company's Housatonic well field. This development by the Bridgeport Hydraulic Company will upon completion, (total development yield = 40 mgd) exhaust the economical ground water resources available to the company in its service area. The New Haven Water Company plans to install 8 additional wells as needed, in presently owned wellfields. These wells are estimated to have a safe yield of an additional 6 mgd.

5. Present Water Supply Systems

a. General. The utility companies which provide water supply to the state of Connecticut are largely, (about 82%) private investor-owned companies. In sub-region No. 19 there are about 72 water utilities. Of this number 12 are municipally owned and 60 are private investor-owned systems. The population served by these utilities vary from less than 100 to more than 300,000. The systems specifically studied in this report are those which are presently serving a population of 50,000 or more. One exception to this criteria was the City of Norwalk, which had a 1960 population of 67,775 and is served by two municipally owned water companies. It was felt that this city, because of its size, should be included in the study even though neither of the two companies could by itself qualify under the "NEWS" population criteria of 50,000 population. These two companies were combined and are presented as Norwalk 1st and 2nd Taxing District hereinafter.

The systems, therefore, which were specifically studied in this study are eight in number, 3 municipally owned, and 5 private investor-owned systems. A listing of these water utilities with population served and average daily demand in 1965 are shown in Table 1.

TABLE 1 ⁽¹⁾

<u>Municipally Owned Systems</u>	<u>1965 Service Population</u>	<u>Water Demand MGD</u>
Meriden Water Department	55,000	6.2
Waterbury Water Department	113,600	15.5
Norwalk 1st & 2nd Taxing District	68,500	8.8
<u>Private Investor Owned Systems</u>		
Bridgeport Hydraulic Company	321,000	60.3
Connecticut Water Company (2)	96,100	10.9
Greenwich Water Company	60,000	12.6
New Haven Water Company	386,000	55.2
Stamford Water Company	<u>80,000</u>	<u>11.9</u>
Total	1,180,200	181.4

(1) Based upon Data Developed by Public Service Research for "NEWS" Group.

(2) Entire population serviced by company; includes Northern Division which is outside of sub-region No. 19.

The municipalities presently served by these utilities within and in proximity to the sub-region are shown in Table 2 and on Plate No. 2.

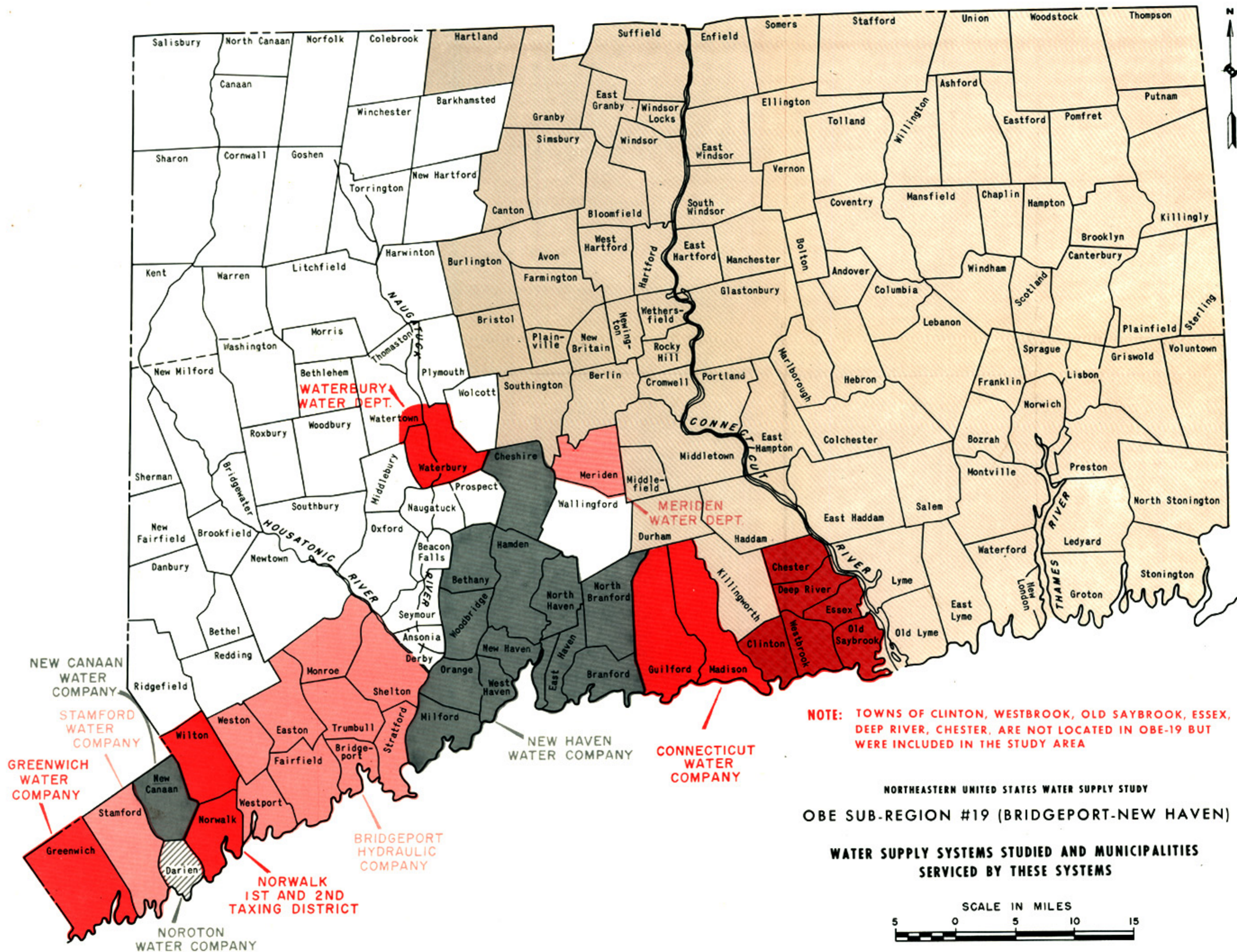


Table 2
Municipalities Served

<u>Municipally Owned Systems</u>	<u>City (ies)</u>	<u>Town (s)</u>
Meriden Water Department	Meriden	
Waterbury Water Department	Waterbury	Middlebury, Watertown
Norwalk 1st & 2nd Tax Dist.	Norwalk	Wilton
<u>Private Investor Owned Systems</u>		
Bridgeport Hydraulic Co.	Bridgeport	Stratford, Fairfield
	Shelton	Trumbull, Easton,
		Weston, Westport,
		Monroe
Connecticut Water Co. (1)		Thomaston, Plymouth,
		Naugatuck, Prospect,
		Beacon Falls, Guilford,
		Madison, Clinton, West-
		brook, Old Saybrook,
		Essex, Chester, Deep
		River
Greenwich Water Co.		Greenwich
New Haven Water Co.	New Haven	Bethany, Cheshire,
	West Haven	East Haven, Hamden,
	Milford	North Haven, Orange,
		Woodbridge, Branford,
		North Branford
Stamford Water Co.	Stamford	Darien

(1) Guilford-Chester Division, Thomaston Water Co., Naugatuck Water Co., Terryville Water Co.

These eight systems serviced about 89% of the total serviced population in the study area and supplied approximately 91% of the water supply demand of the sub-region in 1965. Although the smaller water systems were not studied specifically in this report their estimated effect upon the major systems future water supply plans was evaluated.

b. Consolidation of Service Areas for Study Purposes.

Due to the preliminary scope of this report the eight major water utilities heretofore described are further consolidated for ease in presentation. This consolidation consists of four sub-areas of the sub-region. These are: South-west Fairfield County, Bridgeport Hydraulic Company Service Area, New Haven-Connecticut Water Company(1) Service Area and the Waterbury-Meriden Area. The municipalities which compose the sub-areas are as follows:

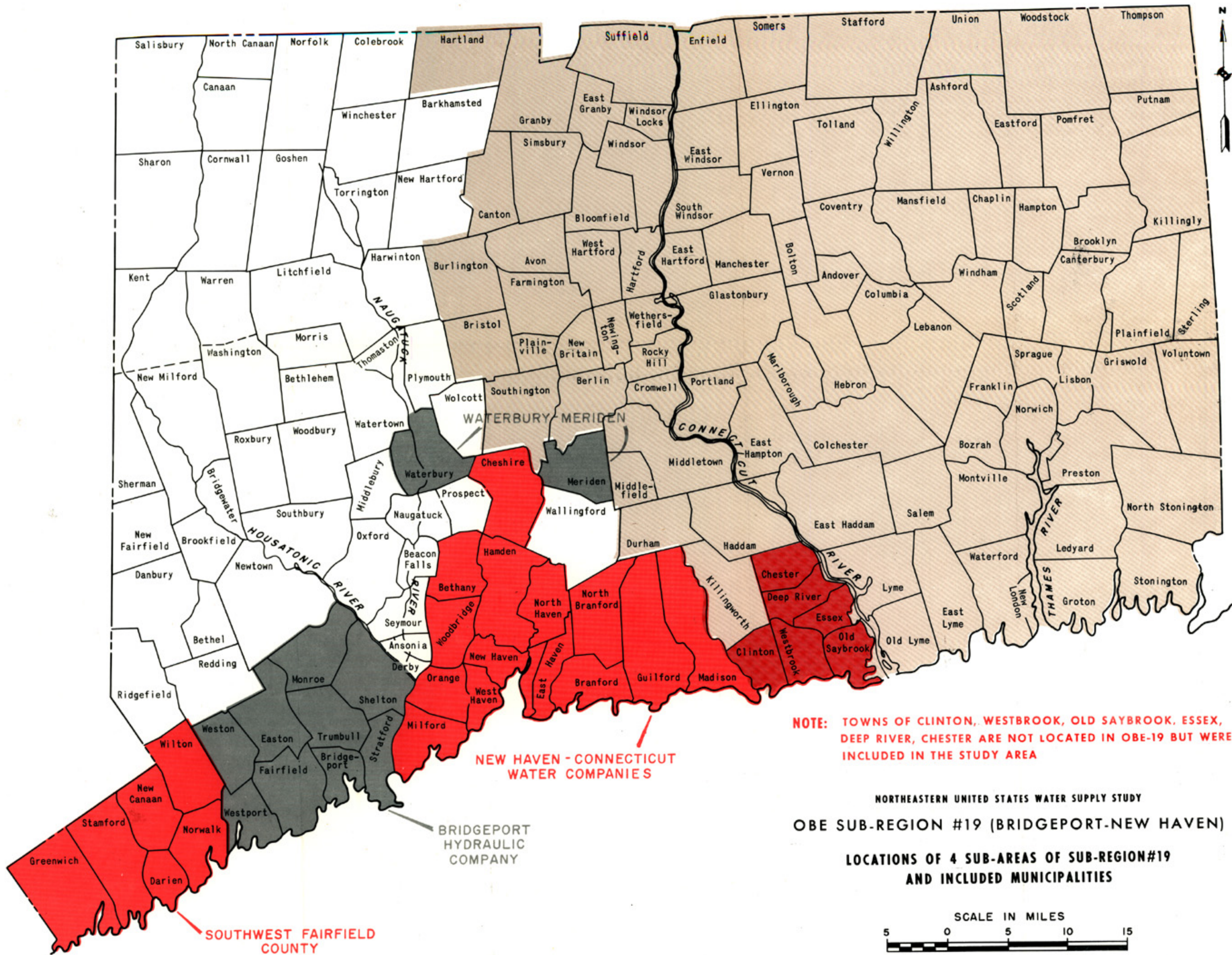
<u>Sub-Areas</u>	<u>Municipalities</u>
1. Southwest Fairfield County	Norwalk, Wilton, Darien, New Canaan, Stamford, & Greenwich
2. Bridgeport Hydraulic Co. Service Area	Monroe, Shelton, Stratford, Trumbull, Bridgeport, Easton, Fairfield, Weston and Westport
3. New Haven - Connecticut Water Companies Service Area	Chester, Deep River, Essex, Old Saybrook, Westbrook, Clinton, Madison, Guilford, North Branford, North Haven, East Haven, Cheshire, Hampden, New Haven, West Haven, Bethany, Woodbridge, Orange, Milford and Branford
4. Waterbury-Meriden Service Area	Meriden, Waterbury, Watertown, and Middlebury

The location of these sub-areas and the included municipalities are shown on Plate No. 3.

c. Southwest Fairfield County Water Supply Systems.

The water utilities in this sub-area draw the majority of their water supply from the surface water resources of the small coastal streams and rivers which drain the area. There are a total of 20 reservoirs and lakes which impound water for water supply in the area. These reservoirs have a combined capacity of about 9 BG, including about

(1) Guilford-Chester Division of Connecticut Water Company



0.9 BG of storage located wholly or partially in New York state, and an estimated safe yield of about 35 mgd. (1) These surface sources are supplemented by ground water wells which yield about 2 mgd. Treatment facilities in the area vary, depending upon the quality of the source, from full filtration to in some cases simple chlorination, PH adjustment and fluoridation.

d. Bridgeport Hydraulic Company Service Area. The Bridgeport Hydraulic Company has 9 reservoirs for water supply storage throughout the service area. Of these, Saugatuck, Hemlocks, Easton and Trap Falls reservoirs are the most significant. These reservoirs with a combined total storage capacity of about 24.6 BG have an estimated safe yield of about 49 mgd. In addition to its surface sources the Company has conducted extensive searches for ground water and at present has developed about 24 mgd of a well field with an estimated total potential of about 40 mgd. The Company also has sent a "Letter of Intent" indicating its desire to participate in the Trumbull Dam and Reservoir currently under design by the Corps of Engineers. This reservoir was studied in the report cited in paragraph 3-C and will add an additional 9 mgd to the safe yield of the system. No filtration is provided to water supplied to the system, only disinfection, ph adjustment, polyphosphate addition and fluoridation.

e. New Haven-Connecticut Water Companies Service Areas. The New Haven-Connecticut Water Companies draw their water supply principally from surface water sources. There are a total of 19 reservoirs with a total combined storage capacity of about 22.3 BG and a safe yield of about 63 mgd. Ground water sources developed at present, supply an additional 10.7 mgd to the systems. Future ground water development is expected to yield an additional 6 mgd to the system. Treatment of the water varies from full filtration to chlorination, ph adjustment and fluoridation.

f. Waterbury-Meriden Service Area. This area draws its water supply from a system comprised of 8 reservoirs with a total combined storage of about 8.4 BG, with an estimated yield of about 33 mgd. Ground water sources provide an additional 3 mgd at present and sites with an estimated 3 mgd yield have been tested. Treatment facilities vary from filtration plants to disinfecting and fluoridation apparatus.

(1)Based on information supplied by Bridgeport Hydraulic Company

6. Projected Future Water Requirement

The population projections and future water requirements presented in this report are of a preliminary nature and do not include any possible major shift of industries which now utilize private water supplies to the systems in this report. The projections and future water demands are, however, of sufficient accuracy to provide a reasonable comparison between available resources and future requirements affording an outline of potential deficit areas.

The service population projections as shown in Table 3 are shown for the Connecticut Coastal Region and the Waterbury-Meriden Region. The sub-region was separated into these components because it is felt that the future water sources for these areas will differ because of geographic and topographic considerations.

The City of Port Chester, New York, was included in this study for planning purposes since the city is served by a water company whose parent company includes the Greenwich and Noroton Water Companies and any plans made for these companies would affect Port Chester also. The effect of this municipality with a projected 2020 population of 65,000 and water demand of 9.8 mgd, although small in comparison to the total sub-region's requirements, was felt to be of significant size for the planning purposes of this report.

TABLE 3

SERVICE POPULATION PROJECTIONSCONNECTICUT COASTAL REGION

	<u>1980</u>	<u>2000</u>	<u>2020</u>
Connecticut Water Company(1)	40,400	98,300	134,000
New Haven Water Company(1)	477,600	593,100	730,000
Bridgeport Hydraulic Company(2)	400,100	587,100	978,000
Norwalk 1st & 2nd Taxing Dist. (3)	99,000	162,000	240,000
Noroton Water Company(3)	27,000	37,500	45,000
New Canaan Water Company(3)	17,400	30,000	44,000
Stamford Water Company(3)	104,500	155,000	176,000
Greenwich Water Company(3)	72,200	101,000	135,000
Port Chester Water Works Co. (3)	<u>53,400</u>	<u>61,000</u>	<u>65,000</u>
Totals	1,291,600	1,825,000	2,547,000

WATERBURY-MERIDEN REGION

Waterbury Water Department (4&5)	117,800	125,700	161,400
Meriden Water Department(1)	<u>67,500</u>	<u>82,000</u>	<u>97,000</u>
Totals	185,300	207,700	258,400

- (1) Based on population projections by Regional Planning Agency of South Central Connecticut
- (2) Population projections by Pitometer Associates & Hazen & Sawyer Engineers
- (3) Population projections by Hazen & Sawyer Engineers
- (4) Total population of Waterbury as projected by Central Naugatuck Regional Planning Agency
- (5) Includes Oakville Fire District located in Watertown

The projected water demand of the systems with service areas as at present are given in Table 4.

TABLE 4

PROJECTED WATER DEMAND, MGDCONNECTICUT COASTAL REGION

	<u>1980</u>	<u>2000</u>	<u>2020</u>
Connecticut Water Company (1)	6.0	14.7	20.2
New Haven Water Company (1)	75.4	103.8	138.5
Bridgeport Hydraulic Company (2)	80.4	122.0	185.4
Norwalk 1st & 2nd Taxing Dist. (3)	14.4	24.3	36.0
Noroton Water Company (3)	3.2	4.9	5.8
New Canaan Water Company (3)	2.0	3.9	5.7
Stamford Water Company (3)	15.7	23.2	31.0
Greenwich Water Company (3)	10.4	15.6	21.9
Port Chester Water Works Company (3)	<u>7.5</u>	<u>9.2</u>	<u>9.8</u>
Totals	215.0	321.6	454.3

WATERBURY-MERIDEN REGION*

Waterbury Water Department (4)	20.5	28.0	41.5
Meriden Water Department (1)	<u>9.4</u>	<u>14.3</u>	<u>18.4</u>
Totals	29.9	42.3	59.9

*Safe yield both systems 39 mgd, 28 in Waterbury system, 11 in Meriden system

- (1) Based on consumption projections by Regional Planning Agency of South Central Connecticut
- (2) Based on consumption projections by Pitometer Assoc. and Hazen & Sawyer Engr.
- (3) Based on consumption projections by Hazen & Sawyer Engr.
- (4) Includes system continuing to service portions of Watertown.

7. Water Systems Capability to Meet Projected Demands

a. Connecticut Coastal Region. The water companies supplying water to the Connecticut Coastal region in the study area have long relied on the small coastal rivers as their major source. These sources supplemented by ground water, where available, have been adequate to meet demands in general up to present. Demands in the near future however will exceed the dependable safe yield of these sources. The most logical choice for future water supply lies in the as yet generally untapped Housatonic River. The water companies in the region recognize the need and economy of utilizing the Housatonic and plans for developing this source have started. The Connecticut General Assembly through legislation in 1967 laid the groundwork for utilizing the Housatonic by making clear the right of water utilities to utilize river water as a source of supply. In addition, the Legislature in another Act specifically amended the Bridgeport Hydraulic Company's charter to permit it to take water from the Housatonic River. A plan of the Housatonic River Basin is shown on Plate No. 4.

Water demands of communities located in South West Fairfield County, shown on Plate No. 3 will exceed the safe yield of their present system's resources before 1980. By 1990 the communities served by the Bridgeport Hydraulic Company, shown on Plate No. 3, will also have exceeded their system's safe yield. By the year 2000 the entire Connecticut Coastal Region will be deficit in water supply source. The schedule of water supply deficits expected to occur is shown in Table 5.

TABLE 5

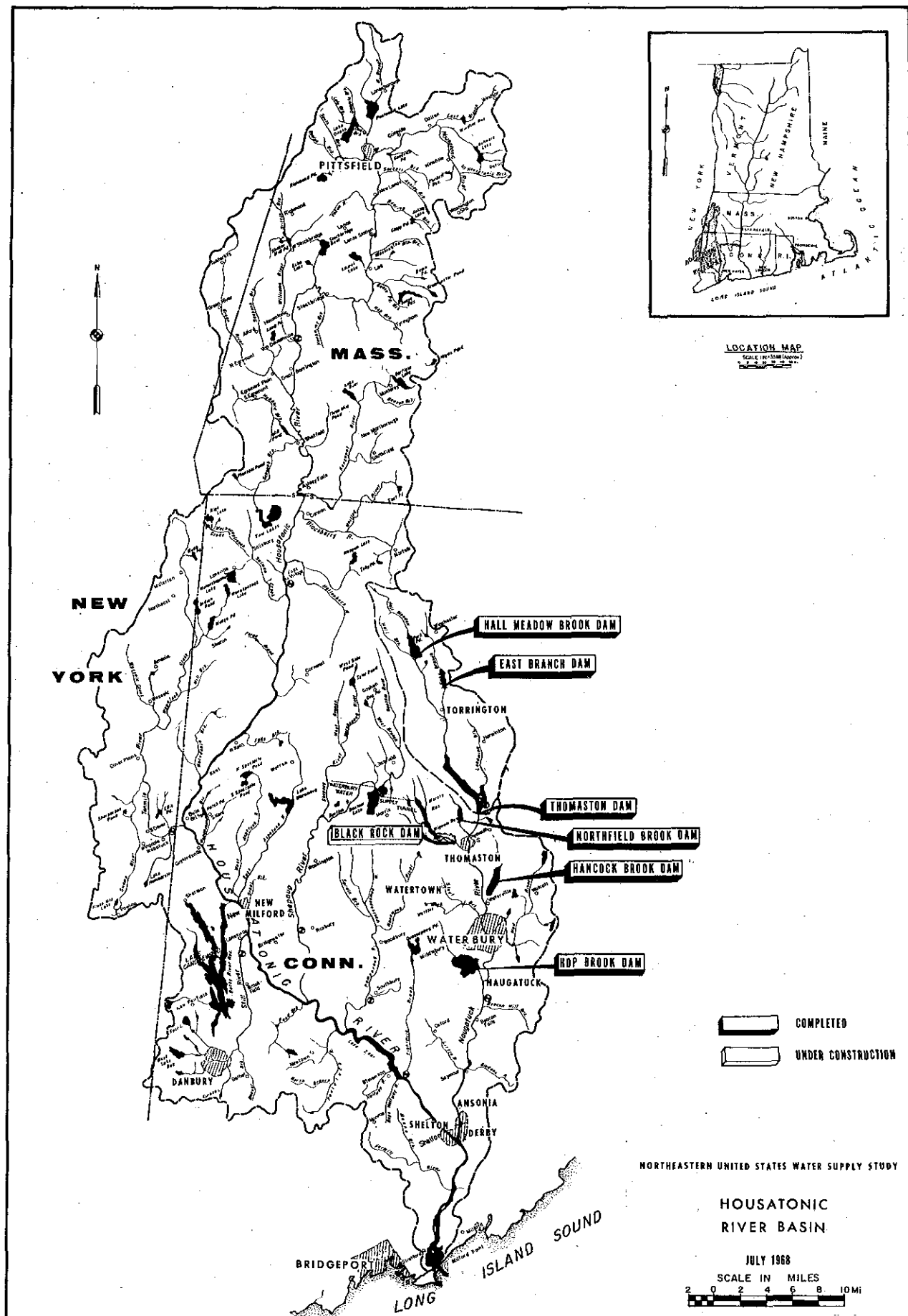
SCHEDULE OF WATER SUPPLY DEFICITS, MGD

	<u>South West Fairfield (2) County</u>	<u>Bridgeport Hydraulic (1) Company</u>	<u>New Haven (3) Water Company</u>	<u>Total Deficit mgd</u>
1970	--	--	--	--
1980	18.2	--	--	18.2
1990	31.8	20	--	51.8
2000	46.5	43.5	10.0	100.0
2010	58.5	68.1	25.7	152.3
2020	75.6	103.9	42.0	221.5

- (1) Based on consumption projections developed by Pitometer Associates and Hazen & Sawyer Engineers.
- (2) Based on consumption projections developed by Hazen & Sawyer Engineers.
- (3) Based on consumption projections developed by the Regional Planning Agency of South Central Connecticut.

b. Waterbury-Meriden Region. The current Waterbury system with its present service coverage should be adequate from a source viewpoint to about 2000. Potential future customers of the system consisting possibly of three projected rapid growth towns could by their addition cause the system's requirements to exceed its safe yield by about 1985. This possibility of additional communities connecting to the system poses a major question mark as to the systems capability to handle future requirements.

The Meriden system consumption projections indicate this system's safe yield will be exceeded by about 1985.



Other neighboring communities, including Wallingford, which will have a deficit about 1985, will probably experience source shortages also.

8. Communities Not Presently Served by the Existing Systems

a. Connecticut Coastal Region. The franchise areas of the water companies presently serving the coastal region provide good coverage of the municipalities which form a band along the coast. Plate No. 2 illustrates the system coverage of the various companies. Many of these municipalities, in particular those which are not located on the coastline, have areas suitable for future development and population growth. Since projections indicate urban population growth will rise greater than the sub-region growth the present service areas were felt, for purposes of this report, to represent the practical limits of the existing systems. Further more detailed studies may reveal other communities which might be served but only the presently serviced communities were evaluated in this study.

b. Waterbury-Meriden Region. In addition to the presently serviced municipalities, the Waterbury Water System will possibly be approached by at least three other municipalities for water supply. These municipalities, Prospect, Wolcott and Middlebury at present have little or no public water supplies. Growth in these towns is expected to be substantial in the future due to their proximity to Waterbury the urban core of the area. Addition of these communities to the Waterbury system would increase the demand upon the system and the safe yield of the system would be exceeded by about 1980. These communities and their expected water requirements are shown in Table 6.

TABLE 6

Potential Municipal Customers of the Waterbury System⁽¹⁾

	<u>Prospect</u>		<u>Wolcott</u>		<u>Middlebury</u>		<u>Totals</u>	
	<u>Pop.</u>	<u>Demand</u>	<u>Pop.</u>	<u>Demand</u>	<u>Pop.</u>	<u>Demand</u>	<u>Pop.</u>	<u>Demand</u>
1980	7,400	1.3	13,500	2.4	8,100	1.4	29,000	5.1
2000	14,300	3.0	23,000	4.8	19,900	4.2	57,200	12.0
2020	20,800	5.0	33,600	8.0	29,800	7.1	84,200	20.1

(1) Based upon projections developed by Central Naugatuck Valley Regional Planning Agency

If these communities are connected to the Waterbury system, the total demand upon the system would be as shown in Table 7.

TABLE 7
POTENTIAL FUTURE WATER DEMAND, MGD
WATERBURY SAFE YIELD = 28 mgd.

	<u>Demand</u>	<u>Surplus</u>	<u>Deficit</u>
1980	27.0	1.0	--
2000	39.8	--	11.8
2020	61.6	--	33.6

These estimates are preliminary and more detailed study would be required to determine the exact effect of these communities joining the Waterbury system.

The Meriden water system, which itself is expected to be deficit in water supply by about 1985, probably would not entertain any ideas of expanding its system coverage at this time, while communities surrounding Meriden are expected to grow rapidly in the future. Any plan which might solve Meriden's future water problems would also include the municipalities surrounding the city. The population and consumption projections for Meriden and its largest neighbor in the study area, Wallingford are shown in Table 8.

TABLE 8

POPULATION AND CONSUMPTION PROJECTIONS⁽¹⁾

	<u>Meriden</u>			<u>Wallingford</u>			<u>Totals</u>	
	<u>Pop.</u>	<u>Water Demand</u>	<u>Deficit Surplus</u>	<u>Pop.</u>	<u>Water Demand</u>	<u>Deficit Surplus</u>	<u>Pop.</u>	<u>Deficit Surplus</u>
1980	67,500	9.4	+1.4	49,000	6.3	+2.8	116.5	+4.2
2000	82,000	14.3	-4.0	68,500	11.7	-2.6	150.5	-6.6
2020	97,000	18.4	-7.6	79,000	15.1	-5.9	176.0	-13.5

9. Deficit Areas within the Sub-Region

a. Connecticut Coastal Region. The portion of the coastal region which lies in the Southwestern portion of Fairfield County, from the City of Norwalk to the New York State Line is considered an urgent need. Projections indicate this area will be deficit in water supply source by 1980. Within the decade following, the service area of the Bridgeport Hydraulic Company will also be deficit. By the year 2000 the entire coastal region west of the Connecticut River to Port Chester will have exceeded the safe yield of their present sources and shall be forced to look beyond their boundaries for other water supply sources.

The Housatonic River is the logical choice as a source for the future water supply requirements of this region. Plans for development of the Housatonic for water supply have already been initiated by various water companies of the region.

The Housatonic River Basin has a drainage area of 1545 square miles at its apparent downstream withdrawal which is just below Stevenson Dam. The drainage area of the Naugatuck (312 sm) a tributary of the Housatonic has been largely neglected as a water supply source as the mainstem is badly polluted in the vicinity of the region. However, the headwater tributaries of the Naugatuck which are unpolluted were considered as a source for those municipalities in proximity to them. The yield from the drainage area considered (ie 1545 sm) has an average annual value of , about 1600 mgd.

(1) Based on projections prepared by the Regional Planning Agency of South Central Connecticut

Based on consumption projections the estimated deficit by 2020 of the Connecticut Coastal Region is 212 mgd. If this deficit is increased to 300 mgd for planning purposes the Housatonic River still possesses a large unused water supply potential.

b. Waterbury-Meriden Region. The preliminary scope of this report and lack of available data in the Waterbury-Meriden area create many questions as to the capability of these systems to meet future water supply requirements. At this time the Waterbury system without any additions to its service area might be adequate to about 2000 but growing suburban communities will probably pressure to be admitted to the system. These additions could cause the systems' safe yield to be exceeded about 1985.

The Meriden system appears to be adequate to about 1985 but the system is basing its capacity to meet these demands on ground water supplies whose yield values may be overestimated.

Many unknowns exist regarding the capability of the systems in this area to meet future requirements. A more detailed study than the scope of this report allows is required to analyze the systems in this region.

10. Inter-Basin-Inter-State Diversion Considerations.

New York City and its environs will shortly face a water supply deficit of major proportions. The future water needs of the system in mgd are shown in Table 9.

TABLE 9 (1)

NEW YORK WATER SYSTEM DEMAND PROJECTIONS

<u>Service Area</u>	<u>1980</u>	<u>2000</u>	<u>2020</u>
Primary ⁽¹⁾	1430	1730	2060
Secondary ⁽¹⁾	40	170	290
TOTAL	1470	1900	2350

(1) Based on a report by Metcalf & Eddy, Hazen & Sawyer, and Malcolm Pirnie Engineers

The safe yield of the New York system based on the performance during the recent drought is now estimated to be 1,278⁽²⁾ mgd. Using this estimate the system faces a water supply deficit of about 200 mgd by 1980. Preliminary estimates indicate that the Housatonic River, in addition to meeting the 300 mgd need of the Connecticut Coastal Region, may be able to supply the New York City system some 500 mgd. This additional supply would enable the New York City system to meet its requirements to about 1995.

A diversion of 500 mgd to the New York City System and a reserving of 300 mgd for the Connecticut Coastal Regions future needs would allow a free flow of 800 mgd in the basin on an average annual basis. The ecological effects of this reduction in flow due to the diversions would have to be evaluated as a factor in the determination of the ultimate suitability of this scheme.

11. Preliminary Plans and Cost Estimates for Future Water Supply Needs, Connecticut Coastal Region

As an approach to the evaluation of the Housatonic River as a water supply source for the Connecticut Coastal Region and possible major diversion to the New York City system, five possible development plans and preliminary cost estimates were prepared. The development plans considered are not to be construed as the optimum plans of development or the only number of feasible plans but rather as illustrative examples of the potential of the available resource. Development plans studied for this report are as follows:

PLAN A - Supplying 300 mgd for water supply use to Connecticut Coastal Region with 240 mgd base flow at Stevenson dam.

PLAN B - Supply 500 mgd for water supply to NYC System and 180 mgd for base flow at New Milford.

PLAN C - Supplying 500 mgd to NYC System with 100 mgd of Connecticut Coastal Region's requirements being delivered through NYC System's facilities and 90 mgd base flow at New Milford.

(2) Based on information contained in a description of the New York City Water Supply System by "NEWS" Group

PLAN D - Supplying 200 mgd for water supply to Connecticut Coastal Region and 240 mgd for base flow at Stevenson dam.

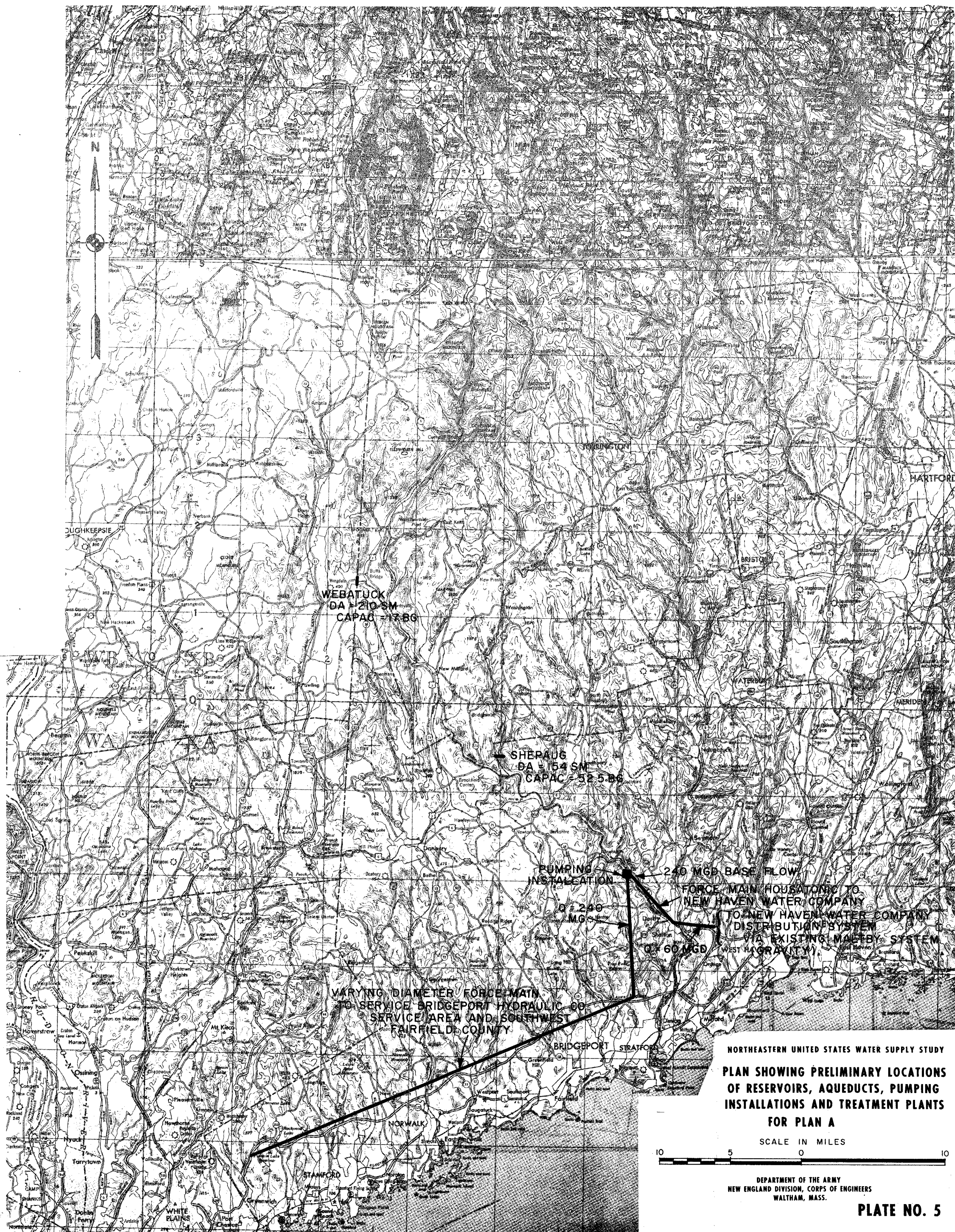
PLAN E - Supplying 300 mgd for water supply use to Connecticut Coastal Region, 500 mgd to NYC system, with 100 mgd of Connecticut requirement being delivered through NYC System's facilities and 240 mgd base flow at Junction of Housatonic and Naugatuck Rivers.

Description of the five plans and preliminary cost estimates are as follows: (1) (2)

PLAN A - Supplying 300 mgd for Water Supply to Connecticut Coastal Regions and 240 mgd for Base Flow at Stevenson Dam.

Proposal provides water from the Housatonic River for only the Connecticut Coastal Region as shown on Plate No. 2. The intake for this plan is assumed to be at the present location of the Bridgeport Hydraulic Company's Housatonic wellfield. From this intake the water is pumped through two separate aqueduct systems, one system feeding the region East of the Housatonic and the other system supplying that portion of the region which lies West of the Housatonic. Preliminary locations and sizes of reservoirs, aqueducts, pumping installations and treatment plants are shown on Plate No. 5. Preliminary cost estimates for Plan A are as follows:

- (1) All cost estimates are based on ENR Index-1200 which is assumed to be the projected level for the year 1970
- (2) Estimate for reservoirs includes Engineering & Design and Supervision and Administration. Estimate shown for E&D and S&A is for facilities exclusive of reservoirs



COST ESTIMATE PLAN A

Reservoirs (Includes E&D and S&A)		\$ 47,100,000
Other Facilities		
Pumping Installations	\$ 8,950,000	
Treatment & Intake Works	40,975,000	
Aqueducts		
Bridgeport-Fairfield	27,250,000	
New Haven	3,150,000	
	<u>80,325,000</u>	
Contingencies 15%	12,050,000	
	<u>92,375,000</u>	
Engineering & Design	10,050,000	
	<u>102,425,000</u>	
Supervision & Administration	7,060,000	
	<u>109,485,000</u>	
Subtotal	\$109,485,000	
		<u>109,485,000</u>
Total		\$156,585,000
Say		\$156,600,000

PLAN B - Supplying 500 mgd for Water Supply to New York City System and 180 mgd for Base Flow at New Milford.

Provides water from the Housatonic River for only the NYC system as shown on Plate No. 6. The intake for this plan is assumed to be in the Lake Candlewood area. Water is pumped from the Housatonic into Lake Candlewood. A tunnel would connect by gravity flow Lake Candlewood to below E. Branch Reservoir whence water flows by gravity through the Croton system to New Croton Reservoir. An aqueduct with pumping connects New Croton Reservoir to the Eastview treatment plant site. Preliminary locations and sizes of reservoirs, aqueducts, pumping installations and treatment plants are shown on Plate No. 6. Preliminary cost estimates for Plan B are as follows:

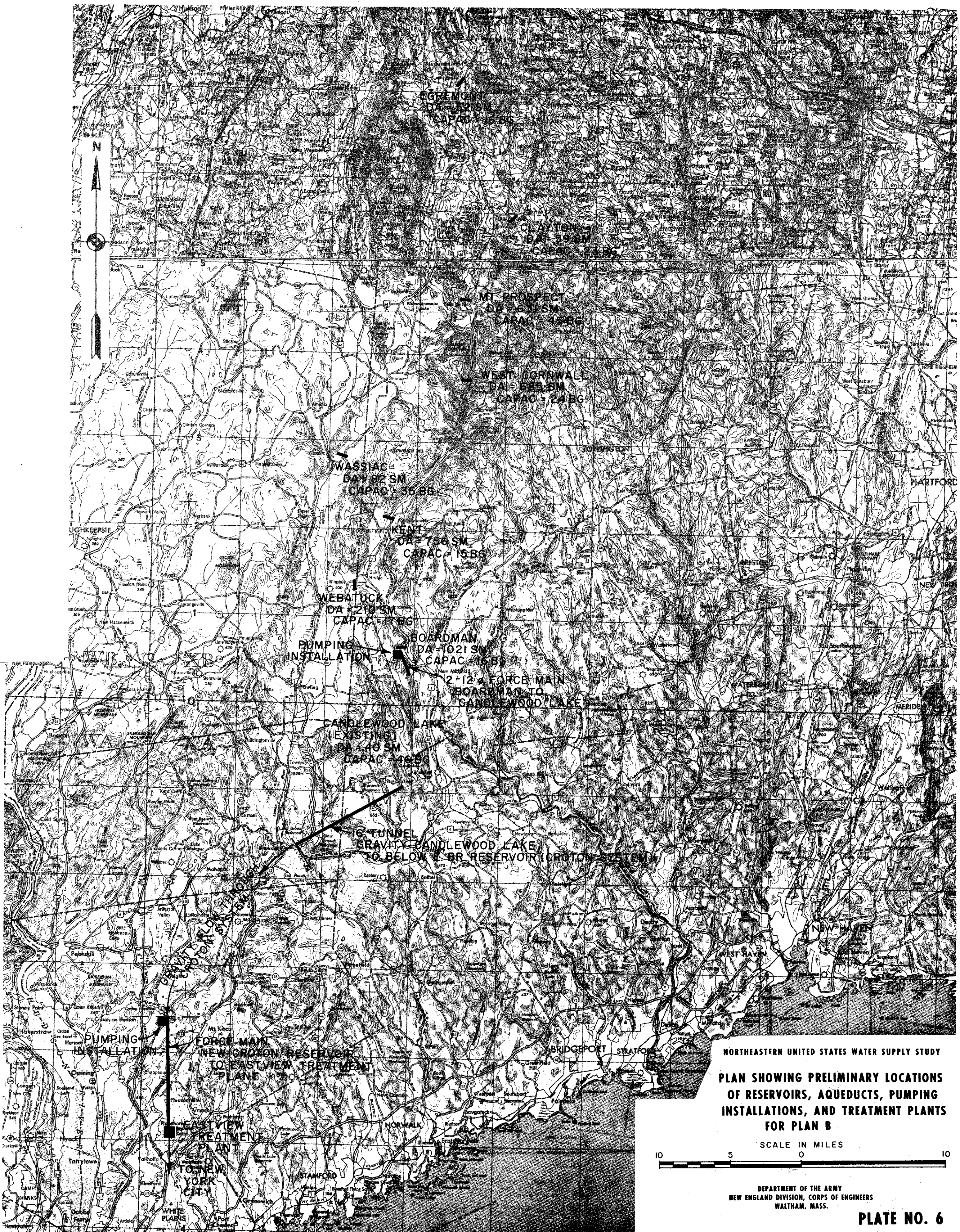
COST ESTIMATE PLAN B

Reservoirs (Includes E&D and S&A)		\$147, 300, 000
Other Facilities		
Pumping Installations	\$ 14, 200, 000	
Treatment & Intake Works	49, 700, 000	
Aqueducts		
Boardman Reservoir		
to Lake Candlewood	10, 800, 000	
Lake Candlewood to		
Croton System	26, 500, 000	
New Croton Reser-		
voir to Eastview	<u>21, 000, 000</u>	
	\$122, 200, 000	
Contingencies 15%	<u>18, 330, 000</u>	
	\$140, 530, 000	
Engineering & Design	<u>13, 620, 000</u>	
	\$154, 150, 000	
Supervision & Adminis-		
tration	<u>11, 170, 000</u>	
	\$165, 320, 000	
		<u>165, 320, 000</u>
Total		\$312, 620, 000
Say		\$312, 600, 000

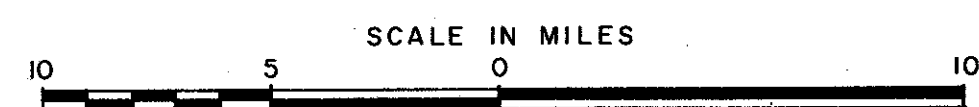
The least costly alternative to this plan based upon a report by three eminently qualified architect-engineer firms appears to be the use of Hudson River water. This plan which would draw and treat water from the Hudson River in the vicinity of Hyde Park and thence through a 16' tunnel to Kensico Reservoir was estimated to cost \$472, 800, 000.

PLAN C - Supplying 500 mgd for Water Supply to NYC System with 100 mgd of Connecticut Coastal Regions Requirements being Delivered through NYC System's Facilities and 90 mgd Base Flow at New Milford.

This plan provides water from the Housatonic River, 500 mgd of which is used by the NYC system and 100 mgd of which



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PLAN SHOWING PRELIMINARY LOCATIONS
OF RESERVOIRS, AQUEDUCTS, PUMPING
INSTALLATIONS, AND TREATMENT PLANTS
FOR PLAN B



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NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

is used by the water companies in Southwest Fairfield county. The physical description of the plan is identical with Plan B as shown on Plate No. 6 except the pumping units, aqueducts and treatment facilities are sized for the additional flow and an additional aqueduct would connect Lake Kensico to the municipalities in Southwest Fairfield County. Preliminary cost estimates for this plan are as follows:

COST ESTIMATE PLAN C

Reservoirs (Includes E&D and S&A)		\$147,300,000
Other Facilities		
Pumping Installations	\$ 15,300,000	
Treatment & Intake Works	55,100,000	
Aqueducts		
Boardman Reservoir to Lake Candlewood	10,800,000	
Lake Candlewood to Croton System	26,500,000	
New Croton Reser- voir to Eastview	31,300,000	
Eastview to Connecti- cut Coastal Region	<u>7,800,000</u>	
	\$146,800,000	
Contingencies 15%	<u>22,020,000</u>	
	\$168,820,000	
Engineering & Design	<u>16,320,000</u>	
	\$185,140,000	
Supervision & Adminis- tration	<u>12,870,000</u>	
Subtotal	\$198,010,000	
		<u>\$198,010,000</u>
Total		\$345,310,000
Say		\$345,300,000

PLAN D - Supplying 200 mgd for Water Supply to Connecticut Coastal Region and 240 mgd for Base Flow at Stevenson Dam.

The proposal would utilize the locations of the intake, pumping installation, treatment facilities and aqueducts identical with that of Plan A. If 100 mgd of the total region requirement of 300 mgd would be supplied through the NYC systems' facilities as outlined in Plan C, these items would only be sized for the net 200 mgd required to meet the regions demand. Preliminary cost estimates for this plan are as follows:

COST ESTIMATE PLAN D

Reservoirs (Includes E&D and S&A)		\$ 61,300,000
Other Facilities		
Pumping Installations	\$ 5,850,000	
Treatment & Intake works	29,700,000	
Aqueducts		
Bridgeport	8,800,000	
New Haven	3,140,000	
	<u>\$47,390,000</u>	
Contingencies 15%	7,110,000	
	<u>\$54,500,000</u>	
Engineering & Design	5,770,000	
	<u>\$60,270,000</u>	
Supervision & Administration	4,425,000	
	<u>\$64,695,000</u>	
Subtotal	\$64,695,000	\$ 64,695,000
Total		\$125,995,000
Say		\$126,000,000

PLAN E - Supplying 300 mgd for Water Supply to Connecticut Coastal Region, 500 mgd to New York City System and 240 mgd for Base Flow at Confluence of Housatonic and Naugatuck Rivers.

Development of the Housatonic River for water supply to service economically the greatest possible population might consist of utilizing some 800 mgd for water supply, with base flow of some

240 mgd. Locations and sizing of reservoirs, aqueducts, pumping installations and treatment facilities are shown on Plate No. 7. Preliminary cost estimates for this plan are as follows:

COST ESTIMATE PLAN E

Reservoirs (Includes E&D and S&A)		\$208,600, 000
Other Facilities		
Pumping Installations	\$ 20, 050, 000	
Treatment & Intake Works	79, 400, 000	
Aqueducts	<u>70, 140, 000</u>	
	\$169, 590, 000	
Contingencies 15%	<u>25, 440, 000</u>	
	\$195, 030, 000	
Engineering & Design	<u>15, 720, 000</u>	
	\$210, 750, 000	
Supervision & Adminis- tration	<u>13, 050, 000</u>	
Subtotal	\$223, 800, 000	
		<u>\$223, 800, 000</u>
Total		\$432, 400, 000

12. Discussion of Plans for Future Water Supply

Preliminary findings are that the Housatonic River possesses a water supply potential excess to the 2020 requirements of the Connecticut Coastal Region. Attempts to utilize this excess to service other metropolitan areas of Connecticut appears to be uneconomical. The only large metropolitan areas in Connecticut outside of Sub-Region 19 are the Hartford-New Britain area in Sub-Region 18 and the New London-Groton-Norwich area in Sub-Region 17. Although the New Britain area might be able to utilize some tributaries of the Naugatuck River for water supply it appears more probable at this time that this area would obtain its future requirements from the Hartford system. The Hartford system in turn would probably more readily utilize the waters of the Connecticut River which are in proximity to the system than to undergo the costly procurement of water from the Housatonic. The New London-Groton-Norwich area appears to have untapped resources in its

immediate area which can probably meet its future water demand. The possibility of this area disregarding these local water sources and importing water across two watershed boundaries appears quite remote.

The New York City system, notably the Croton sub-system appears to be both geographically and topographically situated such as to utilize excess waters from the Housatonic economically. The preliminary first cost estimate of diverting Housatonic water to the NYC system is \$312,600,000 while the forementioned alternate plan of drawing water from the Hudson River in the vicinity of Hyde Park has a first cost estimate of \$432,400,000. Using these cost estimates as a basis, development of the Housatonic appears to have economic merit.

Utilization of the potential Housatonic NYC system as a vehicle to supply some water supplies to a portion of the Connecticut Coastal Regions might prove economically attractive to the State of Connecticut. The cost estimates included in this report however are of such a preliminary nature that an accurate measure of the potential of this scheme could not be determined.

Development of the Housatonic to service both the Connecticut Coastal Region and the NYC system is estimated to cost some \$432 million. It should be noted that this development which would service an additional projected population of some 2.5 million in Connecticut outside the NYC system would cost some \$40 million less than the Hudson River plan which would only service populations within the NYC system.

Utilization of the Housatonic's water resources may also afford an opportunity to develop, coincident with water supply, hydroelectric and recreation opportunities. Construction of the water supply reservoirs and accompanying water surface area of about 27,000 acres, would create a large potential for controlled water based recreation. The basin is ideally situated with respect to all of the major Connecticut metropolitan areas and to the New York City-Northern New Jersey metropolitan complex. Based on "Preliminary Appraisal Public Water Supply Systems and Industrial Water Supply" developed by Public Service Research for "NEWS" the following populations in Table 10 may be expected to be within easy commuting distance (90 miles) of the Housatonic and its recreation opportunities.

TABLE 10

POPULATIONS WITHIN COMMUTING
DISTANCE OF THE HOUSATONIC

	Economic Sub-Regions			<u>Totals</u>
	18 <u>Hartford</u>	19 <u>Bridgeport- New Haven</u>	20 <u>New York City Metro.</u>	
1965	766	1,310	15,400	17,476
1980	971	1,635	18,200	20,802
2000	1,228	2,183	23,900	27,271
2020	1,738	2,998	31,697	36,433

Note: All population in 1,000's

The relationship of the Housatonic River Basin to these metropolitan areas is shown on Plate No. 8.

13. Discussion and Summary

a. Connecticut Coastal Region. The Connecticut Coastal Region with its complex water supply systems will first begin to experience water shortages within the next decade (1980 period). The area estimated to experience the first deficit will be southwest Fairfield County. The water short area is estimated to next extend to the coastal region west of the Housatonic River and it is probable that by the year 2000 the entire coastal region west of the Connecticut River will be unable to meet its water supply requirements from a source viewpoint. However, this analysis does not consider any major breakthrough in the desalination program. The apparent logical choice for additional water supply with current technology is the nearby Housatonic River Basin.

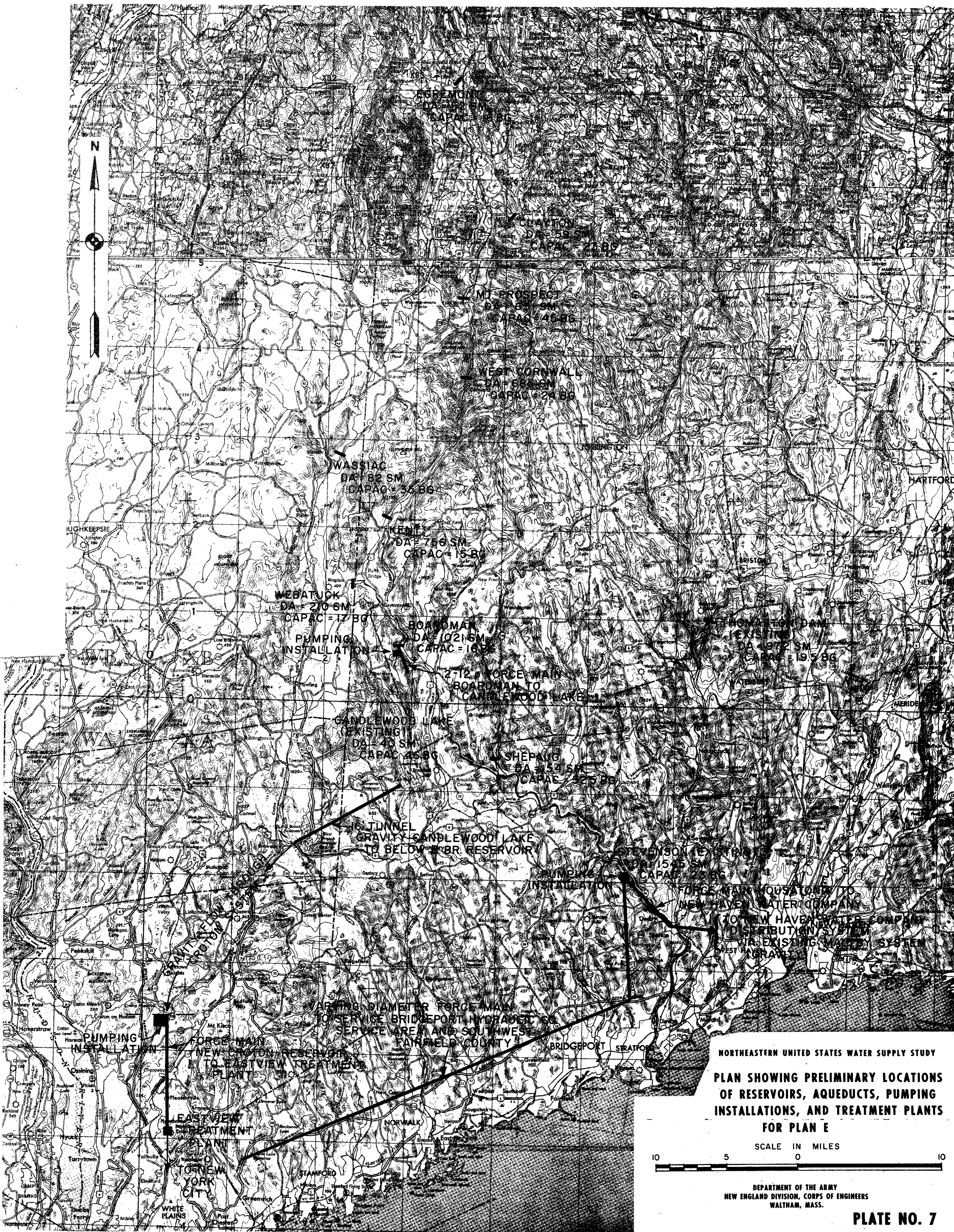
Development of the Housatonic based on this preliminary analysis can readily provide the 300 mgd required for the Connecticut Coastal Region and still possess a large water supply potential. This excess water now discharging into the sea could be put to higher use by providing a future water supply source to Connecticut as well as an immediate source for the New York City system which is estimated to have a 200 mgd deficit by 1980. Preliminary economic analyses appear to favor use of the Housatonic as a source for the New York system rather than the planned Hudson

River proposals. Use of the Housatonic to meet future water requirements of both economic sub-regions 19 (Bridgeport-New Haven) and a great portion of 20 (New York City Metropolis) would afford an interstate broad region solution to a common problem. The problems associated with a plan of this scope however are many and varied and should include consideration of affected utilities (electric and railroad) in the basin. Inherent legal problems of interstate transfer present a particularly delicate complication. The legal problems of interstate-interbasin transfers however have had many precedents to follow, for example, diversion of Colorado River Basin water to California. The advantages of a solution such as outlined would have to outweigh these problems in order to gain acceptability by both states.

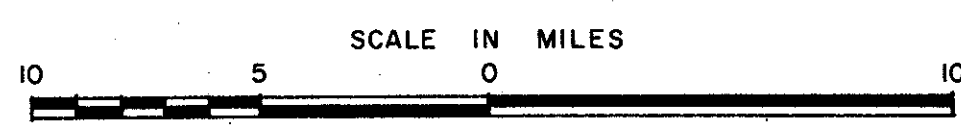
Incentives including monetary remuneration to Connecticut for diverted waters could lend support to justification of development of this valuable resource as a Bi-State Program. This remuneration to Connecticut by New York could be acceptable to New York if the economic advantage of using the Housatonic rather than the Hudson proposal was demonstrated by more detailed studies. The quite preliminary cost estimates prepared in this report indicate the Housatonic proposal could cost New York some 10+ millions less in annual costs (200 million capital cost) than the Hudson proposal. Use of a portion of this reduction in annual costs to compensate Connecticut for diverted waters might prove attractive to both states.

Development of the Housatonic for water supply would provide large surface areas suitable for water based recreation within easy commuting distance of major metropolitan populations. This recreation development would benefit both states as well as Massachusetts and would be particularly beneficial in an economic sense to Connecticut which could expect a major increase in tourist trade. This tourist trade as well as associated industries and services necessary to support this trade would generate income both for local interests and the state treasury. Evaluation of this potential tourist trade in monetary benefits is beyond the scope of this report but is considered substantial.

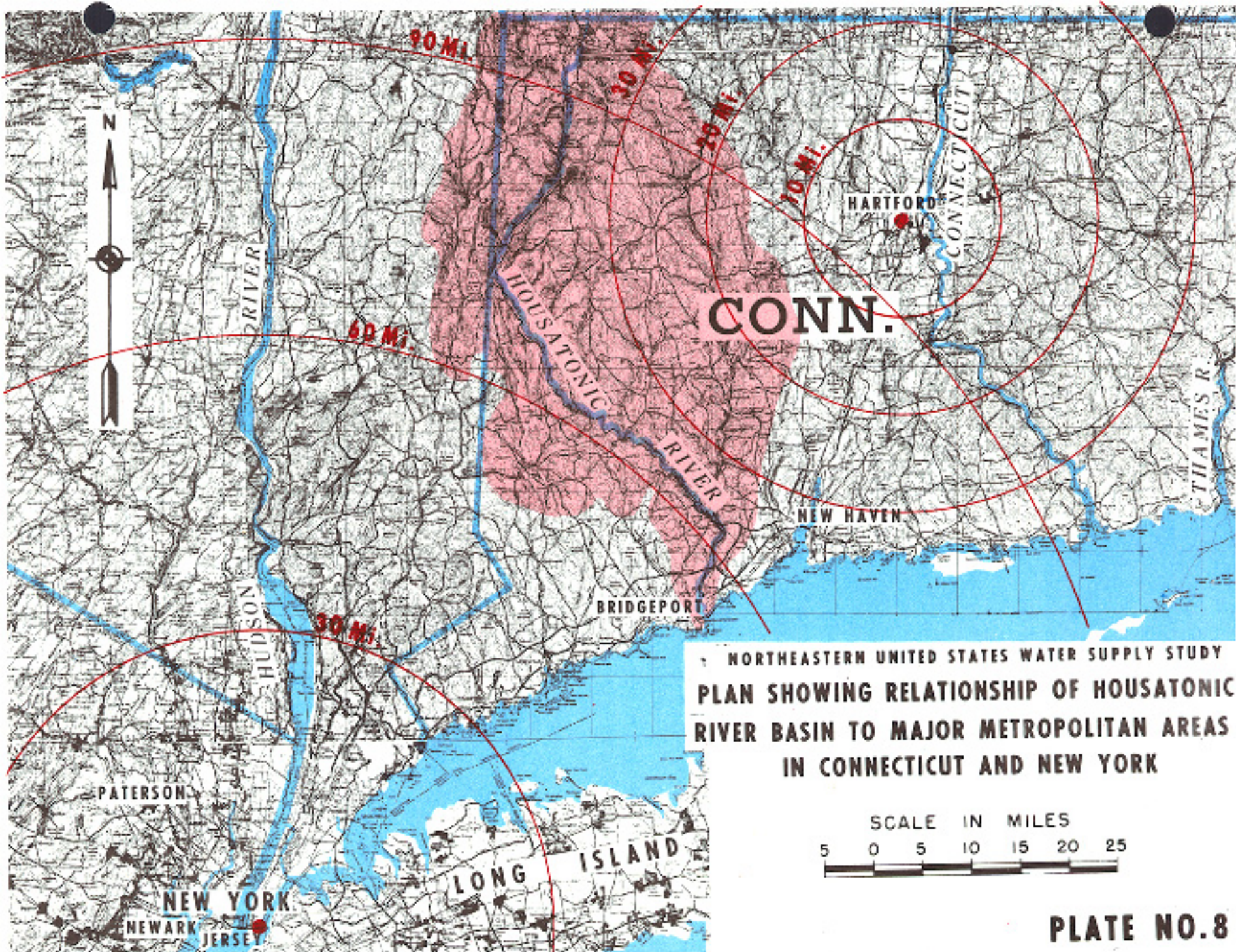
b. Waterbury-Meriden Region. As stated earlier in this report, lack of data and information in this area poses many questions as to the capability of the water systems to meet future



NORTHEASTERN UNITED STATES WATER SUPPLY STUDY
PLAN SHOWING PRELIMINARY LOCATIONS
OF RESERVOIRS, AQUEDUCTS, PUMPING
INSTALLATIONS, AND TREATMENT PLANTS
FOR PLAN E



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.



NORTHEASTERN UNITED STATES WATER SUPPLY STUDY
PLAN SHOWING RELATIONSHIP OF HOUSATONIC
RIVER BASIN TO MAJOR METROPOLITAN AREAS
IN CONNECTICUT AND NEW YORK

SCALE IN MILES
5 0 5 10 15 20 25

requirements. More detailed data must be prepared prior to the formulation of even preliminary planning for this area. This planning would best be prepared concurrently with that for the Connecticut Coastal Region since development of future water resources in this area would probably draw its supply from the headwaters of the Naugatuck, a tributary of the Housatonic.

14. Further Study Required

The preliminary nature of this study does not permit the recommendation of conclusive engineering proposals. The report does however point to those areas which could expect a water supply deficit and outlines a broad general engineering plan to meet these water supply requirements. Further development of this plan requires a more complete study, items which would be included in this further study⁽¹⁾ for Recommendations A and B are as follows:

1. Hydrology
2. Water Supply Requirements
3. Identification of Urgent Water Supply Areas
4. Required Water Supply Storage for Target Years Demand
5. Investigation of Reservoir Sites
6. Sizing and Routing of Conveyance Facilities
7. Sizing and Location of Treatment Facilities
8. Effect of Plan on Other Related Water Uses
 - a. Recreation
 - b. Pollution Abatement
 - c. Power
 - d. Flood Control
 - e. Navigation
9. Ecological and Environmental Considerations
10. Cost Studies
11. Recommendations and Findings
12. Implementation of System Development

(1) Develop physical sizing, costs etc. and alternatives such that decisions can be made on features which are deserving of further detailed engineering of survey scope coverage.

15. Recommendations

In order to insure an adequate and dependable future water supply for the sub-region, the following courses of action are recommended:

a. Study of the Housatonic River for use as a source for future water supply needs and development of plans and more detailed cost estimates necessary to utilize this supply on a regional basis in the Connecticut Coastal Region. This engineering study would provide plans and alternates for the development of this resource. It is estimated to cost \$200,000.(1)

b. Study of the Housatonic River to determine the feasibility, both physical and economic, and limitations of providing water supply for both the future needs of the Connecticut Coastal Region and immediate needs of the New York City system. This study would, after feasibility was ascertained, develop plans and alternative plans to provide optimum development of the resource to meet the widest possible requirements. The cost estimate for this recommendation is \$350,000.(1)

c. Study of the Waterbury-Meriden area to determine in detail future water supply needs. Investigation of available resources ability to meet these needs and plans for development of this resource. It is desirable that this study be conducted concurrently with either a or b above as any major resource development in this area would affect to a degree the plans which a or b might develop. However, because of the lack of information as to the needs of this area it is felt that this portion of the sub-region should be studied separately for at least the initial phase (identification of need areas) of the report. Accordingly funds of \$20,000 are required to undertake this study.

(1) These study cost estimates are based upon a "rough" estimate. It would be desirable to program $\frac{1}{4}$ to $\frac{1}{2}$ of this amount as an initial phase to determine further the feasibility or advisability of the plans outlined in this report.